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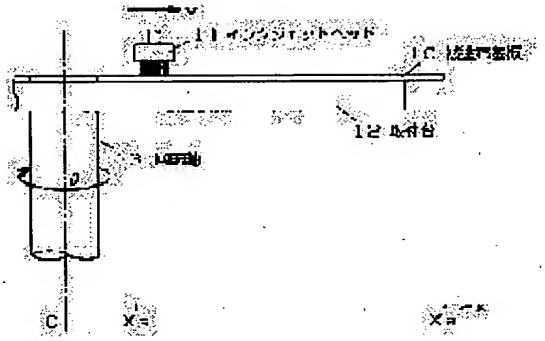
(54) THIN FILM FORMING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To improve efficiency in utilizing a coating soln. by relatively rotating a substrate to be coated and an ink-jet head while controlling the angular speed and traveling velocity, relatively moving the substrate and head between a region on the rotating shaft side and a region on the side remote from the region and forming a coating film.
SOLUTION: A substrate 10 to be coated is rotated at an angular speed of θ, an ink-jet head 11 is relatively moved at a velocity of V in the radial direction of the substrate 10, and a coating soln. is discharged from a nozzle to coat the substrate. Accordingly, the specified number of coating lines, e.g. 48, are formed at a specified distance, e.g. 100μm, from one another by the head 11 after one full rotation of the substrate 10. As a result, the stripes of prescribed width, e.g. 4.8mm is drawn. The lines are connected by appropriately selecting the line width, and a thin film having a specified thickness is formed. The head 11 is composed by arranging many micronozzles, e.g. 48, in the radial direction of the substrate 10 with the spacings of about 10units/mm.



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CLAIMS

[Claim(s)]

[Claim 1] The ink jet head which has two or more detailed nozzles which carry out the regurgitation of the liquid, A rotation means to rotate the coated substrate which adheres to the liquid breathed out from said ink jet around a predetermined revolving shaft, the alienation which estranged said ink jet head and said coated substrate from the near field of said revolving shaft over said coated substrate, and said revolving shaft -- with the relative-displacement means made displaced relatively between fields the relative position of said ink jet head and said coated substrate -- said alienation from said near field -- the thin film deposition system which has the relative-displacement control means which controls said relative-displacement means so that it corresponds for being displaced relatively toward a field and the rate of relative displacement by said relative-displacement means becomes small.

[Claim 2] The ink jet head which has two or more detailed nozzles which carry out the regurgitation of the liquid, A rotation means to rotate the coated substrate which adheres to the liquid breathed out from said ink jet around a predetermined revolving shaft, the alienation which estranged said ink jet head and said coated substrate from the near field of said revolving shaft over said coated substrate, and said revolving shaft -- with the relative-displacement means made displaced relatively between fields the relative position of said ink jet head and said coated substrate -- said alienation from said near field -- the thin film deposition system which has the relative-displacement control means which controls said relative-displacement means so that it corresponds for being displaced relatively toward a field and the angular velocity of rotation by said rotation means becomes small.

[Claim 3] The ink jet head which has two or more detailed nozzles which carry out the regurgitation of the liquid, A rotation means to rotate the coated substrate which adheres to the liquid breathed out from said ink jet around a predetermined revolving

shaft, the alienation which estranged said ink jet head and said coated substrate from the near field of said revolving shaft over said coated substrate, and said revolving shaft -- with the relative-displacement means made displaced relatively between fields Correspond for being displaced relatively toward a field and the rate of relative displacement by said relative-displacement means becomes small. the relative position of said ink jet head and said coated substrate -- said alienation from said near field -- and the relative position of said ink jet head and said coated substrate -- said alienation from said near field -- the thin film deposition system which has the relative-displacement control means which controls said relative-displacement means so that it corresponds for being displaced relatively toward a field and the angular velocity of rotation by said rotation means becomes small.

[Claim 4] a relative-displacement control means -- the relative position of an ink jet head and a coated substrate --, the alienation from the near field -- the thin film deposition system according to claim 1 or 3 which slows down the rate of relative displacement in inverse proportion to the migration length displaced relatively toward a field.

[Claim 5] a relative-displacement control means -- the relative position of an ink jet head and a coated substrate -- the alienation from the near field -- the thin film deposition system according to claim 2 or 3 which slows down a rotational angular velocity in inverse proportion to the migration length displaced relatively toward a field.

[Claim 6] Furthermore, a thin film deposition system given in either of claims 1-5 which flow airstream into said coated substrate immediately after having adjoined the ink jet head, having prepared the airstream appearance head into which airstream is made to flow toward a coated substrate, and breathing out a liquid to said coated substrate.

[Claim 7] Furthermore, a thin film deposition system given in either of claims 1-6 which have an electrification means to electrify the liquid breathed out from an ink jet head.

[Claim 8] A thin film deposition system given in either of claims 1-7 to which an ink jet head carries out the regurgitation of the liquid by countering with a liquid delivery, preparing an air delivery, making airstream flow out from said air delivery, and changing the balance condition of the fluid pressure in said liquid delivery, and the air pressure near [which is produced by said airstream] the liquid delivery.

[Claim 9] Furthermore, the thin film deposition system according to claim 8 with which the liquid which has a potential difference impression means to impress the potential difference between the electrode member prepared in the perimeter of an air delivery, and said electrode member and liquid in a liquid delivery, and was breathed out from the ink jet head is charged.

[Claim 10] A thin film deposition system given in either of claims 1-9 whose liquids which carry out the regurgitation from an ink jet head are UV hardening resin solutions.
[Claim 11] A thin film deposition system given in either of claims 1-10 whose coated substrates are the products made from a polycarbonate.
[Claim 12] A thin film deposition system given in either of claims 1-11 whose relative-displacement control means are the personal computers with which the control program was incorporated.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention relates to the equipment which is made to dry and harden the liquefied matter which breathed out the liquefied matter from the minute nozzle, was made to adhere to a substrate about a thin film deposition system, and adhered, and forms a thin film (it generally has thickness 10 micrometers or less by 100 micrometers or less in a wide sense.).

[0002]

[Description of the Prior Art] In recent years, thin film coating technology is applied in various fields, and spin spreading, printing, a die coat, etc. are variously examined also about the concrete formation method in addition to a spatter or what has required vacuum devices like vacuum evaporationo.

[0003] In this, it is often used for resist spreading in a semi-conductor process, protective coat formation, etc. especially about the spin spreading method.

[0004] Hereafter, the conventional spin coater (it is hereafter described as a spin coater.) is explained.

[0005] Drawing 10 shows the conventional configuration and conventional operating state of a general spin coater. As for a liquid and 107, in drawing 10 , the nozzle to which 101 carries out the regurgitation of the revolving shaft of a spin coater body and the liquid for [102] spreading in a sample fixed substrate and 103, the substrate for thin film formation in 104, and 105 and 106 are [a thin film and 108] scattering drops.

[0006] In such a configuration, it changes into the condition of having carried the liquid 105 discharge and in the shape of a substrate toward the substrate 104 from the nozzle 103, as [show / first / by drawing 10 (a)].

[0007] Next, as shown in drawing 10 (b), a spin coater is rotated at a low speed omega 1, and a liquid 106 is familiarized with a substrate 104.

[0008] And it is made to rotate at a high speed omega 2 further, and a thin film 107 is made to form on a substrate 104, as shown in drawing 10 (c).

[0009]

[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional configuration, the scattering drop 108 which disperses and becomes useless will arise, and 80 - 90% of a liquid will be thrown away as shown in drawing 10 (c).

[0010] This is because a holiday part will arise into the bad part of concordance with a substrate 104 if a liquid 105 is not made to breathe out so much.

[0011] Thus, in the conventional spin coater, it had the technical problem that the utilization ratio of a liquid was bad and made useless a great portion of coating liquid.

[0012] Moreover, since liquid flows in the direction of a periphery from the inside in forming the film by the spin coater, inevitably, the thickness of a periphery part will become thick and will cause curvature of the disk itself.

[0013] This invention solves the technical problem of the above-mentioned conventional technique, introduces a new liquid discharge head, and aims at offering a thin film deposition system with the high use effectiveness of coating liquid.

[0014]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the thin film deposition system of this invention The ink jet head which has two or more detailed nozzles which carry out the regurgitation of the liquid, A rotation means to rotate the coated substrate which adheres to the liquid breathed out from said ink jet around a predetermined revolving shaft, the alienation which estranged said ink jet head and said coated substrate from the near field of said revolving shaft over said coated substrate, and said revolving shaft -- with the relative-displacement means made displaced relatively between fields the relative position of said ink jet head and said coated substrate -- said alienation from said near field -- it has the main configuration with the relative-displacement control means which controls said relative-displacement means so that it corresponds for being displaced relatively toward a field and the rate of relative displacement by said relative-displacement means becomes small.

[0015] You may be what controls said relative-displacement means so that it corresponds for being displaced relatively toward a field and the angular velocity of rotation by said rotation means becomes small. or this relative-displacement control means -- the relative position of an ink jet head and a coated substrate -- said alienation from said near field -- Correspond for being displaced relatively toward a field and the rate of relative displacement by said relative-displacement means becomes small. the

relative position of said ink jet head and said coated substrate -- said alienation from said near field -- and the relative position of said ink jet head and said coated substrate -- said alienation from said near field -- said relative-displacement means may be controlled so that it corresponds for being displaced relatively toward a field and the angular velocity of rotation by said rotation means becomes small.

[0016] and these cases -- the relative position of an ink jet head and a coated substrate -- the alienation from the near field -- it is suitable to slow down the rate of relative displacement in inverse proportion to the migration length displaced relatively toward a field, or to slow down a rotational angular velocity.

[0017] Furthermore, you may have the configuration which flows airstream into said coated substrate immediately after having adjoined the ink jet head, having prepared the airstream appearance head into which airstream is made to flow toward a coated substrate, and breathing out a liquid to said coated substrate.

[0018] Furthermore, you may have an electrification means to electrify the liquid breathed out from an ink jet head.

[0019] An ink jet head counters with a liquid delivery, prepare an air delivery, and airstream is made to flow out from said air delivery. Moreover, the fluid pressure in said liquid delivery, The electrode member desirable [it / the configuration which carries out the regurgitation of the liquid by changing a balance condition with the air pressure near / which is produced by said airstream / the liquid delivery] and prepared in the perimeter of an air delivery further in this case, It has a potential difference impression means to impress the potential difference between said electrode members and liquids in a liquid delivery, and the liquid breathed out from the ink jet head may be charged.

[0020] And UV hardening resin solution is usable, into the liquid which carries out the regurgitation from an ink jet head, a coated substrate has an usable thing made from a polycarbonate, and its personal computer with which the control program was incorporated is usable into it as a relative-displacement control means.

[0021]

[Function] while rotating a coated substrate and an ink jet head relatively in this invention, controlling angular velocity and passing speed -- the field by the side of a revolving shaft -- and -- a long distance -- it is displaced relatively between near fields and discharge and the spreading film of a homogeneous good condition are formed for a liquid on a coated substrate from two or more minute nozzles of an ink jet head to a coated substrate.

[0022] Furthermore, when an airstream appearance head is prepared, airstream flows into a coated substrate immediately after breathing out a liquid to a coated substrate.

[0023] Furthermore, when an electrification means to electrify the liquid breathed out from an ink jet head is established, the adhesion part of a drop which adhered to the coated substrate previously, and the drop which reaches a coated substrate next repel each other, and the liquid to which it adhered on the coated substrate as a result moves in the direction which spreads more.

[0024]

[Example] Hereafter, each example of this invention is explained to a detail, referring to a drawing.

[0025] (Example 1) Drawing 1 is the outline block diagram of the spin coater in the 1st example of this invention.

[0026] In drawing 1 , 10 is a disc-like coated substrate and, as for an ink jet head and 12, 11 is [a mount and 13] revolving shafts.

[0027] Here, an ink jet head makes a liquid breathe out from a detailed nozzle (for it to be usually a diameter of a nozzle 0.1mm or less.), and means the thing which the discharge condition of a liquid is controlled [thing] by the electrical signal, and makes a liquid adhere to the recorded body with it.

[0028] The ink jet head in this example has such two or more minute nozzles, and, specifically, 48 nozzles are arranged by radial [of the coated substrate 10] at intervals of ten [/mm].

[0029] While the regurgitation nozzle currently conventionally used for the spin coater becomes as [draw / so that explanation may be given below by using the thing with a bore of 0.5-1mm, and using the ink jet head defined as mentioned above like this example although control of minute discharge quantity is difficult / a detailed pattern], the uniform and very thin film can be formed.

[0030] Rotating the coated substrate 10 with angular velocity theta first, as shown in drawing 1 , the ink jet head 11 is made displaced relatively at a rate v to radial [of a coated substrate], coating liquid is made to breathe out and coating liquid is made to adhere on the coated substrate 10 from a nozzle in this example.

[0031] Then, when the coated substrate 10 rotates one time, by the ink jet head 11, 48 applied Rhine will be generated at intervals of 100 micrometers, and stripes with a width of face of 4.8mm will be drawn as a result.

[0032] Furthermore, in this case, if selection of the width of face of each Rhine is appropriate, adjoining Rhine will be connected and the thin film of predetermined thickness will be formed.

[0033] Therefore, if the movement magnitude by the relative-displacement rate v of the ink jet head 11 while such suitable conditions are found out and the coated substrate 10

rotates one time is set as 4.8mm, a thin film can be formed by the so-called spiral picture drawn without lifting the brush from the paper.

[0034] Furthermore, it is not such a picture drawn without lifting the brush from the paper, and a thin film can be formed as for overwrite several times.

[0035] That is, if formation of a thin film is possible and the ink jet head 11 is carried out in this way by setup with the relative-displacement rate v of the ink jet head 11, and the angular velocity theta of the coated substrate 10 even if it carries out the coated substrate 10 in rotation [what] and it carries out overwrite specified quantity, for example, while making it displaced relatively 4.8mm, dense Rhine finer [ten / /] than mm will be drawn, and it is suitable for forming a thinner thin film certainly.

[0036] If radial distance is more specifically set to x by making the core of rotation of the coated substrate 10 into Zero O in drawing 1 , the coated substrate 10 rotates with angular velocity theta, and moving to radial [of a coated substrate] (x directions) at a rate v, the ink jet head 11 will start the regurgitation in a location xs, will stop the regurgitation in the periphery location xe of the coated substrate 10, and will complete thin film formation.

[0037] Here, in order to form a thin film with equal thickness over the whole region of the coated substrate 10, when the discharge quantity from an ink jet head is constant value Q, it needs to satisfy following (several 1).

[0038]

[Equation 1]

$v = k1 / x$

（但し、k 1 は定数）

[0039] Moreover, in order to draw Rhine by the same resolution over the whole region of the coated substrate 10, it is necessary to satisfy following (several 2).

[0040]

[Equation 2]

$\theta = k2 / x$

（但し、k 2 は定数）

[0041] That is, in a disc-like substrate, since v needs to be slowed down as it goes to the method of outside [core] since spreading area increases in the method of outside [core], and peripheral speed turns into a high speed depending on the method of outside [core] for an engine speed to be fixed, in order for the peripheral speed in the record location of an ink jet head to be fixed, x needs to be slowed down for it as an engine speed also

becomes large.

[0042] For example, in a central part, since peripheral speed is slow, it is thick in a central part, but, Rhine of a central part becomes thick, the thin film will arise in a periphery part, Rhine of a periphery part does not lap depending on the case, but the consistency of spreading Rhine may remain that v and theta are in the condition of constant value, while [same] it has been Rhine.

[0043] Moreover, although it becomes fixed [coverage] throughout a coated substrate when theta is constant value where (several 1) is satisfied Since spreading is made by Rhine thin in the periphery section, and high-density by spreading being made by Rhine where a central part is late, its peripheral speed is thick, and a consistency is low, the periphery section may have the bad lap of Rhine in the center section, although spreading Rhine laps well and the uniform film is formed, and coating unevenness may arise.

[0044] Like these examples, it is uniform throughout a coated substrate, and in order to form the thin film fixed [thickness's] (several 1) (several 2), it is desirable to satisfy at least one side and to satisfy these both sides more suitably.

[0045] Next, drawing 2 is the mimetic diagram showing the typical configuration of the ink jet in this example.

[0046] drawing 2 -- setting -- 11 -- an ink jet head and 21 -- for a pressure-regulator style and 24, as for an airstream inlet port and 26, liquid input and 25 are [the source of air supply, and 22 / a liquid pool and 23 / an air delivery and 27] liquid deliveries.

[0047] Here, the liquid delivery 27 and the air delivery 26 are formed on the ink jet head 11 concentric circular.

[0048] And to the ink jet head 11, through the pressure-regulator style 23, airstream is flowing and the airstream of the rate of flow more fixed than the air delivery 26 is flowing out of the source 21 of air supply from the airstream inlet port 25.

[0049] On the other hand, from the liquid pool 22, coating liquid is supplied through the liquid input 24. Moreover, it connects also with the liquid pool 22, a pressure is impressed to the liquid in the ink jet head 11, the source 21 of air supply balances with the air pressure in about 27 liquid delivery produced by airstream, and coating liquid is held in the liquid delivery 27.

[0050] Next, drawing 3 is the enlarged drawing of the nozzle part of drawing 2 . As drawing 3 (a) shows, it is arranged on the concentric circle, the airstream of the fixed rate of flow is flowing out of the air delivery 26, and the pressure Pa generated by this airstream has produced the air delivery 26 and the liquid delivery 27 in the outlet of the liquid delivery 27 with the outflow of that airstream.

[0051] On the other hand, since air pressure is impressed to the liquid pool 22, a pressure Pi arises into the liquid in the liquid delivery 27. And coating liquid will be held by Pa and Pi being almost equal and maintaining balance in the liquid delivery 27.

[0052] On the other hand, if the airstream sent to the ink jet head 20 by the pressure-regulator style 23 decreases as shown in drawing 3 (b), the pressure produced to the outlet of the liquid delivery 27 serves as Pb smaller than Pa, and coating liquid will carry out the regurgitation by differential pressure (Pi-Pb).

[0053] Next, drawing 4 shows the example of a typical configuration of the pressure-regulator style 23. In drawing 4 , the airstream from the source of air supply flows into the inlet port A of a solenoid valve 41, is depended solenoid-valve 41, and flows out via tap holes B and C.

[0054] Here, a solenoid valve 41 changes a tap hole to B or C with an electrical signal.

[0055] When Input A is open for free passage with the tap hole C, it is in the condition of drawing 3 (a), and the pressure Pi of a liquid pool and the pressure Pa by airstream become almost equal.

[0056] And if a regurgitation signal is inputted into a solenoid valve 41, passage will be changed from C to B.

[0057] As shown in drawing 4 , the passage resistor 52 is connected, pressure loss arises by passing this, the pressure by the airstream in an ink jet head will fall to Pb from Pa, will be in the condition of drawing 3 (b), and coating liquid will be breathed out by the tap hole B.

[0058] Now, the example which actually carried out discharge spreading of the coating liquid on the coated substrate is explained using the ink jet head of the above configurations.

[0059] In this example, UV sclerosing solution was used for the coated substrate using the phase-change optical disk made from a polycarbonate that coating liquid should be made the protective coat of a metal vacuum evaporationo side.

[0060] Moreover, the disk diameter was set to 130mm and the spreading range of UV sclerosing solution was used as the part with a radius of about 20mm or more.

[0061] That is, it is set to xs=20mm and xe=65mm in drawing 1 . Moreover, UV sclerosing solution was a resin solution hardened and solidified by irradiating ultraviolet rays, and, specifically, the physical-properties value was viscosity 23cp, specific gravity 1.07, surface tension 29 dyne/cm, and 9.8% of hardening contraction using the acrylic ester constituent.

[0062] Under such conditions, volume required although the protective coat of 5-micrometer thickness is formed estimated it as about 70mg.

[0063] Therefore, since the liquid discharge quantity of an ink jet head is a part for about 300mg/, if it is made for spreading to be completed in about 20 seconds, an about 7-micrometer protective coat will be formed.

[0064] In this case, (several 1) is expressed as shown in following (several 3).

[0065]

[Equation 3]

$$v = 95.6 / x$$

(但し、v：mm／s、x：mm)

[0066] On the other hand, since it was related to the size and the count of two coats (or Rhine consistency) of Rhine about (several 2) at the time of spreading, examination about three cases of k2=32000, and 36000 and 40000 (theta:rpm, x:mm) was performed.

[0067] Using the personal computer, specifically, it controlled so that the rate v and angular velocity theta of the direction of a x axis filled respectively (several 2) (several 3) with software.

[0068] In order to control v according to (several 3), if you express v with the function of time amount, specifically, it is convenient.

[0069] That is, since it is v=dx/dt (several 3), it is changed into the following relational expression of (several 4).

[0070]

[Equation 4]

$$x \cdot dx / dt = 95.6$$

[0071] And when the differential equation shown by (several 4) is solved and x= 20mm conditions are put in by t= 0, since x is expressed with following (several 5), v will be expressed with following (several 6).

[0072]

[Equation 5]

$$x = (191.2t + 400)^{1/2}$$

[0073]

[Equation 6]

$$v = 95.6\ (191.2t + 400)^{-1/2}$$

[0074] Therefore, v will be controlled by the personal computer and actual spreading will be performed so that (several 6) may be filled.

[0075] Drawing 5 is the block diagram of the coater which used the personal computer in this example. In drawing 5 , the same sign is given to the same configuration as drawing 1 , and, for further 51, as for Motor Driver and 53, a motor and 52 are [a personal computer and 54] movable carriages.

[0076] Here, the coated substrate 10 is driven and rotated by the motor 50, and relative displacement of the ink jet head 11 and the coated substrate 10 is made by the motor 51.

[0077] Moreover, although control of motors 50 and 51 is made by Motor Driver 52, Motor Driver 52 is connected to the personal computer 53, and a drive is controlled by software installed in the personal computer.

[0078] And the example which controlled v, theta, and a regurgitation signal to drawing 6 is shown. In drawing 6 , an axis of abscissa shows the location x from the radial core of an optical disk, and an axis of ordinate shows the rate v of the x directions of an ink jet head, and the rotational speed theta of a disk.

[0079] First, in an initial state, an ink jet head is in the location of x= 10mm, and theta is rotating by 1800rpm.

[0080] Next, if an ink jet head starts relative displacement by v=290 mm/s and arrives at the location of x= 20, coating liquid will perform migration and rotation to discharge and coincidence by inputting a regurgitation signal, slowing down v and theta in inverse proportion to x, as shown in drawing.

[0081] And if the location of x= 65 is arrived at, the signal of a regurgitation halt will be inputted and, as for v and theta, a rate and angular velocity will be slowed down by 0.

[0082] Under the above conditions, the observation result about three cases of k2=32000, and 36000 and 40000 (theta:rpm, x:mm) is described.

[0083] First, on condition that k2=32000, since a rotational frequency was low and the consistency of ****** Rhine was rude, there was an inclination for stripes-like irregularity to remain for a while.

[0084] Next, the thin film of 6-8 micrometers of smooth thickness has been formed in the bottom of the condition of k2=36000.

[0085] On the other hand, the centrifugal force arose excessively, since the rotational frequency was too high, the coating liquid which adhered before it during spreading caused a flow, and flowed to the method of outside, and there was an inclination which the stripes of a radial produce under the conditions of k2=40000.

[0086] Therefore, in this case, although the conditions of k2=36000 are more suitable, even if formed under other conditions, according to the class of thin film formed, it is usable.

[0087] In addition, although it is uniform throughout a coated substrate, and it is

desirable suitably that both sides are satisfied in order to form the thin film fixed [thickness's] and (several 1) (several 2), one [at least] conditions are just satisfied depending on the class of target thin film.

[0088] And (several 1) (several 2) sets to this example. On the other hand, conditions at least as mentioned above, or by satisfying both sides Namely, it slowed down as it went to the method of outside [core], and/or as for relative velocity v, the rotational frequency theta was able to form the thin film which x is homogeneity over the coated substrate whole region by slowing down as it becomes large, and thickness's fixed.

[0089] (Example 2) Next, the 2nd example of this invention is explained to a detail.

[0090] Although k1 and k2 can be set up suitably and a desired thin film can be formed according to the conditions according to a class, thickness, etc. of a thin film to form by spreading (several 1) as the example 1 has explained, the further examination may be required by the process of the thin film to form etc. (several 2).

[0091] For example, although spreading was ended in about 10 seconds and experimented by changing k2 of (several 2) to a maximum of 60000 in the case where it is about 3 and k1=191.2 which 5-micrometer thickness could form (several 1), a smooth thin film will not be obtained but a periphery-like striped pattern will remain.

[0092] It is thought that such a phenomenon is produced when the limitation is generated in micrifying of the discharged liquid drop of coating liquid, or when the rotational frequency of a revolving shaft is too low.

[0093] In this example, the configuration which levels irregularity smoothly is offered in consideration of the case where a thin film does not become homogeneity enough only by applying with an ink jet head.

[0094] Drawing 7 is the outline block diagram of the spin coater in the 2nd example of this invention. In drawing 7 , it is the same as that of an example 1 to make the coating liquid discharge head 70 which is an ink jet head displaced relatively, and to form a thin film with the coating liquid of UV sclerosing solution, rotating the coated substrate 10 made from a polycarbonate.

[0095] And further, by this example, a coating liquid discharge head is adjoined and the airstream appearance head 71 is formed, and by spraying airstream immediately after adhering to the coated substrate 10 of coating liquid, coating liquid is made to flow, the spreading film is smoothed, and it has ******.

[0096] Specifically, this example was examined using the same ink jet head and coating liquid as an example 1 by setting up with k2=60000 in k1=191.2 and (several 2) in (several 1).

[0097] First, when the airstream appearance head 71 was not used, the striped pattern

remained and a smooth spreading layer was not obtained.

[0098] On the other hand, like drawing 7 , when airstream appearance HEDDO ** was added, the 3-4-micrometer uniform thin film has been formed.

[0099] An airstream discharge head puts 24 nozzles with a bore diameter of 100 micrometers in order, and, specifically, is about 0.15 kg/cm3. Airstream was made to flow out by the pressure, the exit velocity of air is 100 - 200 m/s extent, and the situation of flow is considered to be the flow of a laminar-flow field [air] with little turbulence.

[0100] Signs that the spreading film is equalized by airstream at drawing 8 are shown. In drawing 8 , Rhine adjoined immediately after discharged liquid adheres to a coated substrate is in the condition by which it was shown in the separated condition ****** field A first.

[0101] Then, although coating liquid is damp, spreads according to the passage of time and it will be in a condition like Field B, the way things stand, it will carry out desiccation hardening, without solving irregularity.

[0102] And if airstream is sprayed before the desiccation hardening, the spreading film of Field B will flow further by concave convex voice, and it will become a uniform thin film like Field C about fine vibration at a target as a result of a lifting.

[0103] As mentioned above, in this example, the coating liquid discharge head was adjoined, the airstream appearance head was prepared, it is immediately after adhering to the coated substrate of coating liquid, and by spraying airstream before desiccation hardening, it flowed, coating liquid was vibrated and the uniform spreading film was able to be formed.

[0104] (Example 3) Next, the 3rd example of this invention is explained to a detail.

[0105] Although this example is for raising the homogeneity of the thin film formed like the example 2, it equalizes a paint film by electrifying discharged liquid.

[0106] Specifically an electrode 93 is formed in the front face of the air delivery 92 of the ink jet head of the same configuration as fundamentally as an example 1, and the potential difference is established according to a power source 90 between this electrode 93 and the discharged liquid 94 currently held in the liquid delivery 91, and it has the configuration which electrifies the drop 95 which carries out the regurgitation, and the same thing as an example 1 was used for the coated substrate 10 or discharged liquid 94.

[0107] Drawing 9 is the enlarged drawing of the nozzle part of the ink jet head of this example. In drawing 9 , the liquid delivery 91 and the air delivery 92 consist of the insulating quality of the materials, and the electrode 93 is formed in the outlet side front face of the air delivery 92.

[0108] And the power source 90 is connected so that the potential difference may be

impressed between the discharged liquid 94 currently held in the electrode 93 and the liquid delivery 91.

[0109] In such a configuration, if the potential difference is impressed according to a power source 90, discharged liquid 94 will be charged according to the electrostatic capacity between an electrode 93 and discharged liquid 94.

[0110] And the drop 95 breathed out by the method of outside charges and flies, and arrives and adheres to the coated substrate 10.

[0111] Thus, the electrified drop 95 maintains the condition of having been charged, when it adheres to the substrate of an insulating material like a polycarbonate.

[0112] And since the adhesion part of a drop 95 which adhered to the coated substrate 10 previously, and the drop 95 which arrives next at the coated substrate 10 wear the charge on the same sign, it will be repelled mutually, and an operation will produce the coated substrate 10 top as a result in the direction in which the liquid to which it adhered spreads more.

[0113] In this example, using the optical disk and UV sclerosing solution made from a polycarbonate, in (several 1), the potential difference of about 600 V was established between an electrode 93 and discharged liquid 94 as k2=60000 in k1=191.2 and (several 2), and, specifically, spreading was ended in 10 seconds.

[0114] And when not electrifying a liquid, the striped pattern remained, a smooth thin film was not formed, but when establishing the potential difference between an electrode 93 and discharged liquid 94 and electrifying discharged liquid, the 3-4-micrometer smooth thin film was able to be formed.

[0115] As mentioned above, in this example, the uniform spreading film was able to be formed by establishing the potential difference between the electrodes and discharged liquid which were prepared in the perimeter of an air delivery, and electrifying discharged liquid.

[0116] in addition, the thing for which the more uniform spreading film can be formed much more certainly by preparing the airstream appearance head which explained in the example 2 further in addition to the configuration charged in the discharged liquid of this example, and combining the configuration which is immediately after adhering to the coated substrate of coating liquid, and sprays airstream before desiccation hardening -- a basis -- it is ****.

[0117] Moreover, in the example of all above, the class of a coated substrate or coating liquid is not limited to what was illustrated, and is a thing electric or applicable also to formation of a functional thin film with an optical function to resist spreading to a silicon substrate, a glass substrate, a ceramic substrate, a metal substrate, etc.

[0118]

[Effect of the Invention] By the above configuration, the thin film deposition system all over a coated substrate which a uniform thin film can formation form can be offered in this invention, without the thickness of a periphery part becoming thick, without making coating liquid useless by the very simple configuration.

[0119] Moreover, various conditions are changed according to the purpose and a thin film deposition system with the high degree of freedom which becomes possible [forming the thin film of predetermined thickness freely] is offered.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The block diagram of the thin film deposition system in the 1st example of this invention

[Drawing 2] The sectional view of the ink jet head of this thin film deposition system

[Drawing 3] The sectional view of the nozzle of the ink jet head of this thin film deposition system

[Drawing 4] The block diagram of the pressure-regulator style of the ink jet head of this thin film deposition system

[Drawing 5] This whole thin film deposition system block diagram

[Drawing 6] The Fig. of this thin film deposition system of operation

[Drawing 7] The block diagram of the thin film deposition system in the 2nd example of this invention

[Drawing 8] The explanatory view of this thin film deposition system

[Drawing 9] The explanatory view of the thin film deposition system in the 3rd example of this invention

[Drawing 10] The explanatory view of the conventional thin film deposition system

[Description of Notations]

10 Coated Substrate
11 Ink Jet Head
12 Mount
13 Revolving Shaft
21 Source of Air Supply
22 Liquid Pool
23 Pressure-Regulator Style
24 Liquid Input
25 Airstream Inlet Port

26 Air Delivery
27 Liquid Delivery
41 Solenoid Valve
42 Channel Resistor
50 Motor
51 Motor
52 Motor Driver
53 Personal Computer
54 Movable Carriage
70 Coating Liquid Discharge Head
71 Airstream Appearance Head
90 Power Source
91 Liquid Delivery
92 Air Delivery
93 Electrode
94 Discharged Liquid
95 Drop

[Translation done.]